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US 6353963 B1

GB 2368005 A

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(54) Abstract Title

Vacuum cleaner with cassette-type reusable filter

(57) A cyclonic vacuum cleaner includes a reusable dust filter 300 removably disposed in a dust chamber of said cleaner. The filter is constructed to facilitate the removal of collected contaminants and for subsequent cleaning. Locking means 500 are provided to lock the filter in position. The filter comprises a filter housing 310 with a cover 320 disposed pivotally thereon, to pivot between an open and a closed position, a washable filter 311 contained in a dust-collecting space 312 in said housing, and a handle 330 pivotally supported on two opposing sides of the filter cover. An observation window 323 may be provided in the filter cover. The locking means comprises semi-cylindrical keys 530 formed on two opposing sides of the handle 330 which mate with corresponding grooves 510 on the dust chamber, two recesses 520 being formed on the end of the grooves in which the keys engage when the handle is rotated. The independent claims are directed to:

- a) A vacuum cleaner characterised by cyclonic suction means, and a removable, reusable filter, said filter being held in place by a locking arrangement,
- b) A vacuum cleaner characterised by a cassette filter disposed therein, said filter comprising a housing, a removable filter disposed on the housing, and a lock mechanism supported on the housing, and
- c) A cassette filter for insertion into a vacuum cleaner characterised by a housing containing a filter and a dust receptacle, an openable cover attached to the housing, and an integrated handle and lock mechanism supported on the cover.

FIG.5

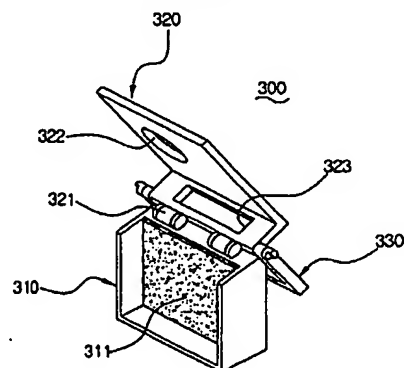
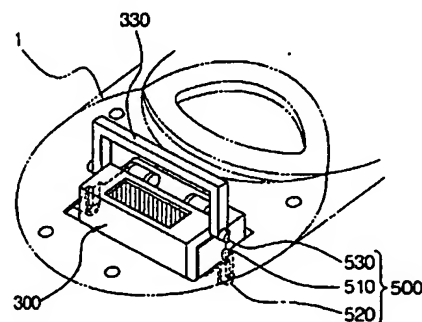


FIG.6



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FIG. 1

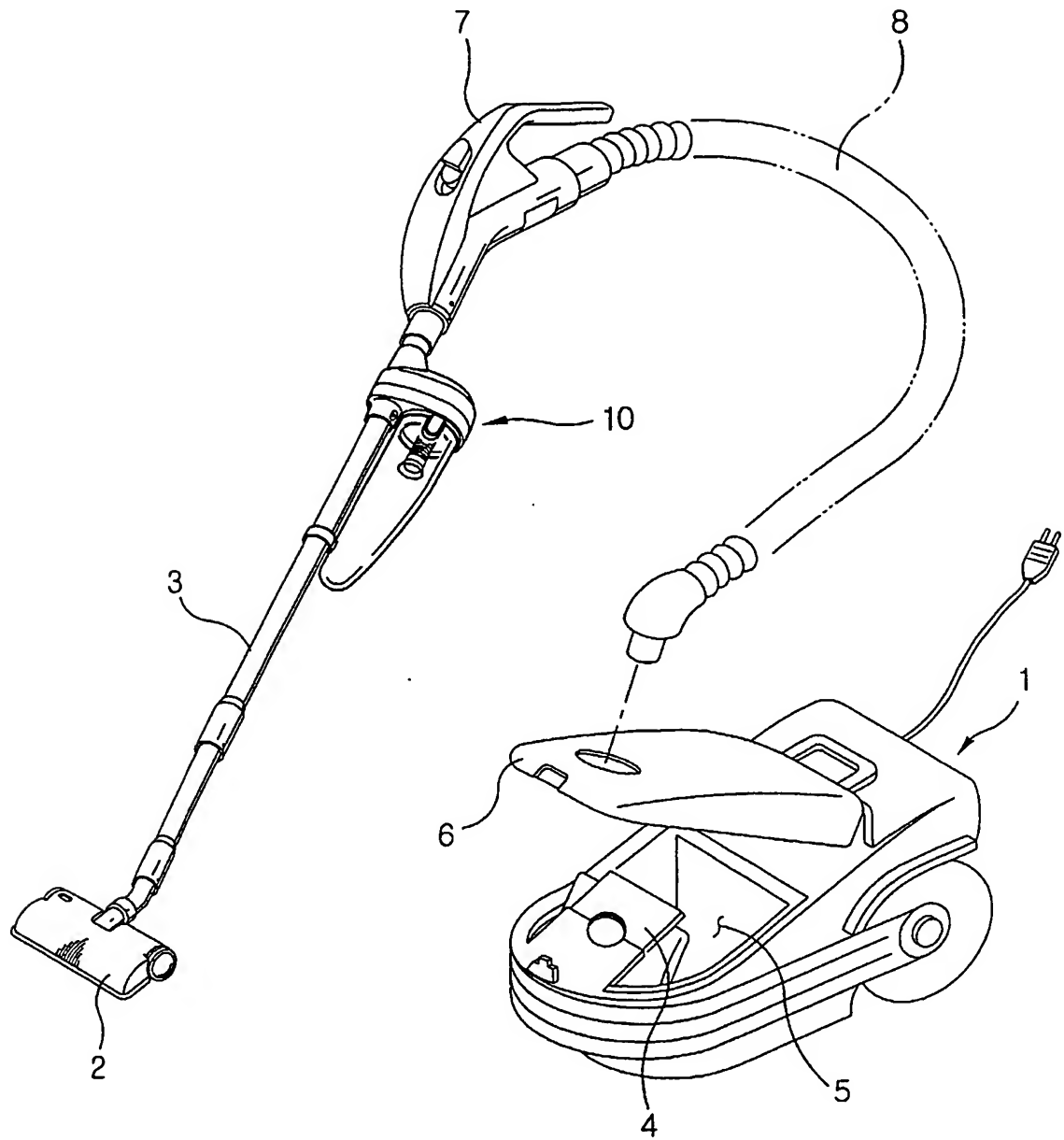


FIG.2

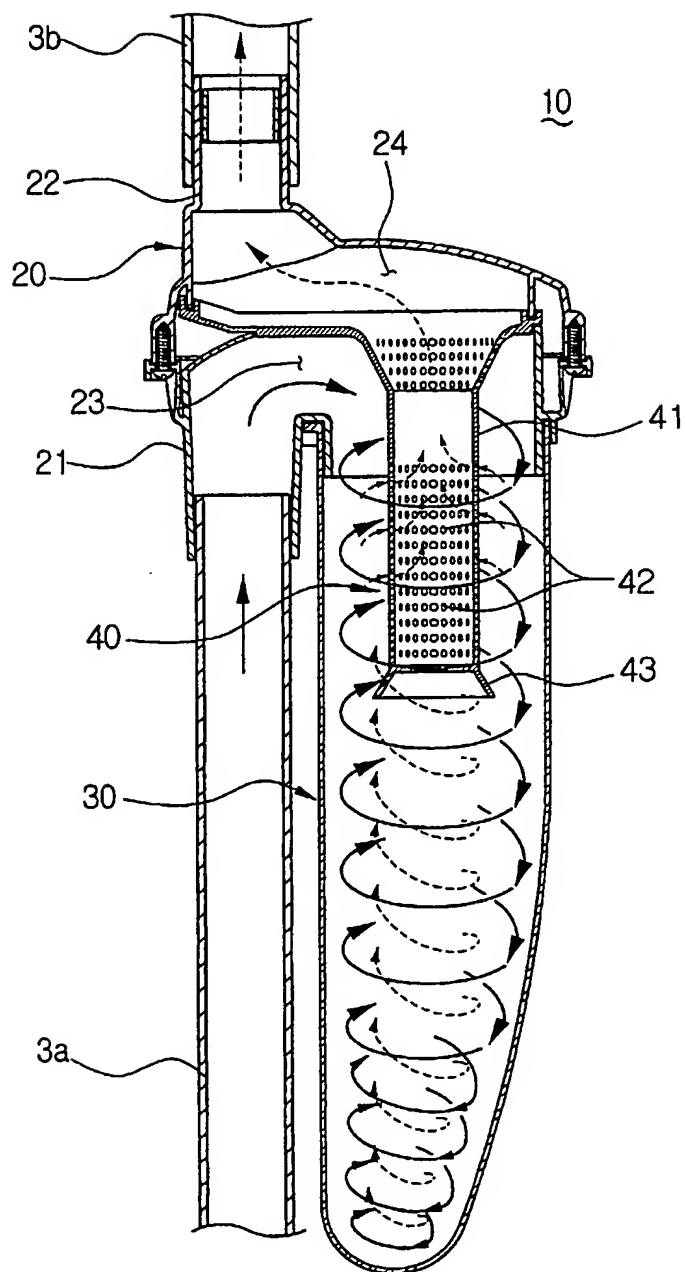


FIG. 3

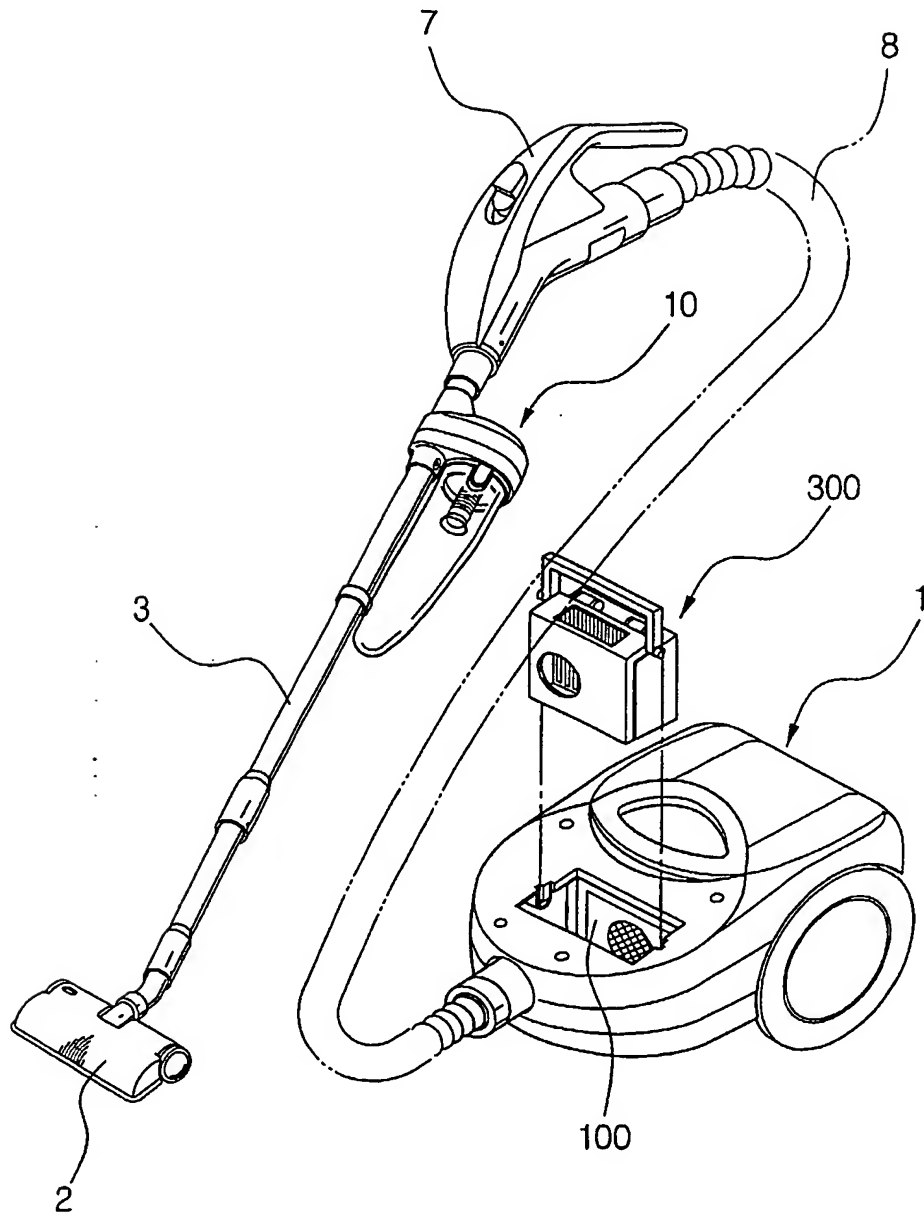


FIG. 4

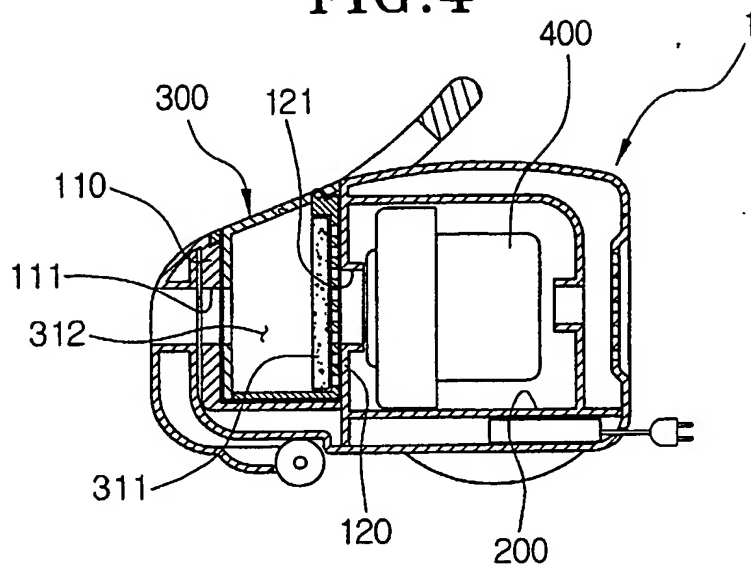


FIG. 5

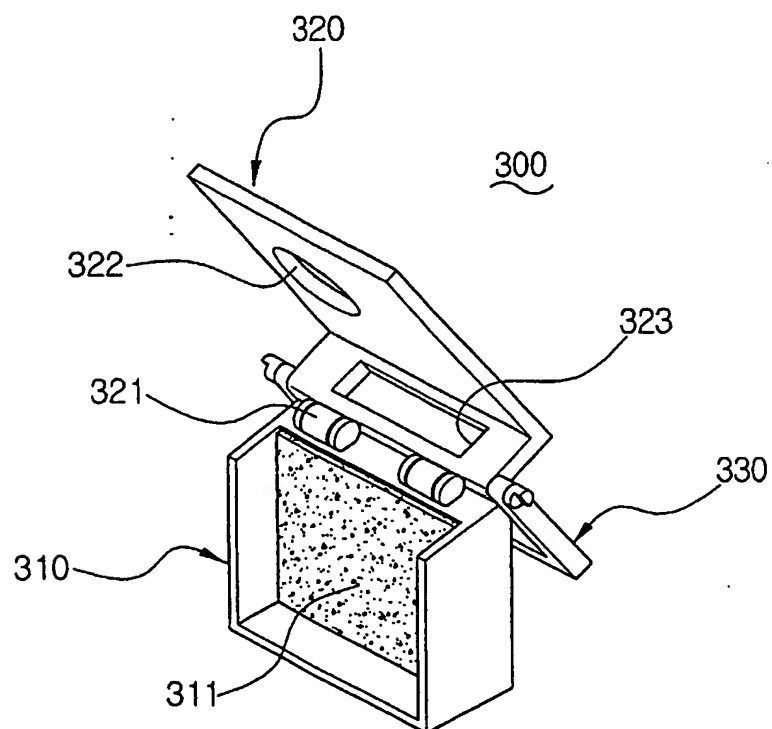


FIG. 6

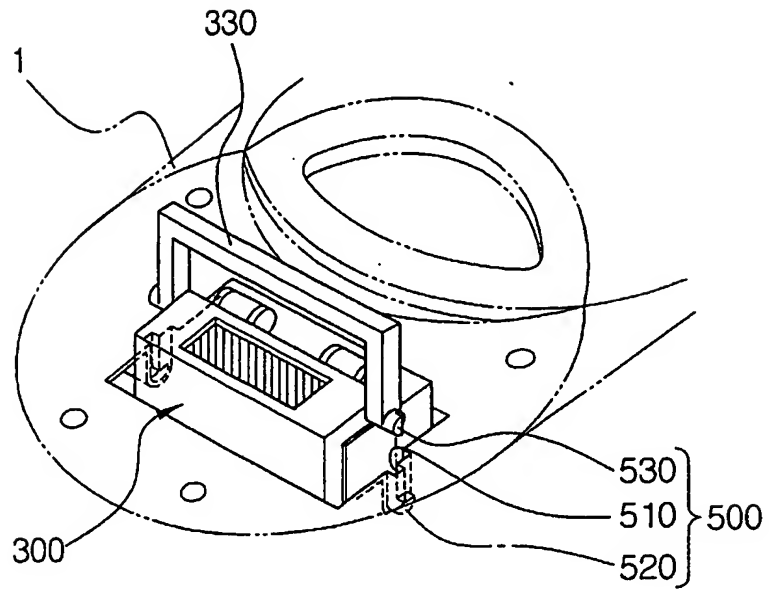
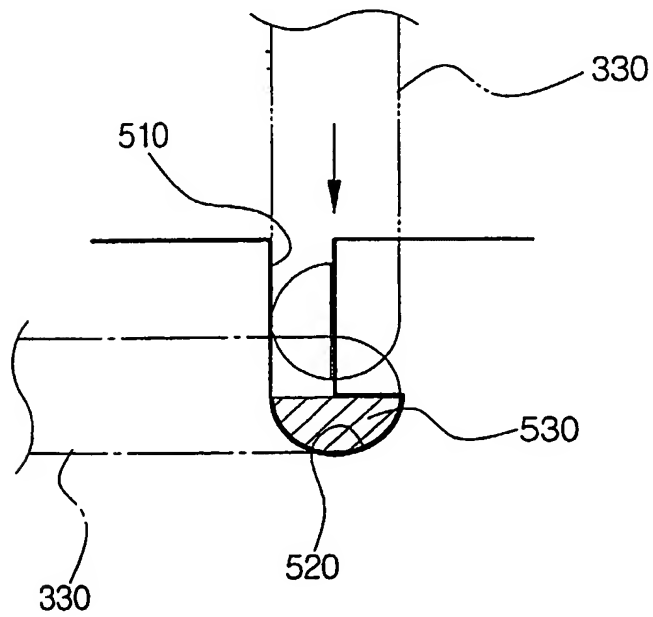


FIG. 7



Vacuum Cleaner With Reusable Filter

This invention relates to a vacuum cleaner, and in particular to a vacuum cleaner having a cyclone dust-collecting apparatus for separating and collecting contaminants from contaminant-laden air with a centrifugal force that is formed by generating an air vortex, and a secondary filter that is removably positioned in the cleaner and can be cleaned and reused.

Our U.S. Patent No. 6,195,835 discloses a vacuum cleaner having a cyclone dust-collecting apparatus. That vacuum cleaner is shown in Figures 1 and 2 which are respectively a perspective view of the cleaner and a sectional view of its cyclone dust-collecting apparatus.

As shown in Figure 1, the vacuum cleaner includes a cleaner body 1, a suction port 2, and a cyclone dust-collecting apparatus 10 disposed between the cleaner body and an extension pipe 3 connected to the suction port.

The cleaner body 1 has a dust-collecting chamber 5, a paper filter 4 disposed within the dust-collecting chamber, and a motor chamber (not shown). A lid 6 is pivotally mounted on the upper portion of the dust collecting chamber 5 for movement between open and closed positions. The extension pipe 3 is connected to a handle 7 and a flexible hose 8, one end of which is connected to the lid 6.

As shown in Figure 2, the cyclone dust-collecting apparatus 10 includes a cyclone body 20, a dust receptacle 30 and a grill assembly 40. The cyclone body 20 includes a first connection pipe 21 connected to a suction port extension pipe 3a, a second connection pipe 22 connected to a cleaner body extension pipe 3b, an air inflow port 23 connected to the first connection pipe 21, and an air outflow port 24 connected

to the second connection pipe 22. In the cyclone body 20, contaminant-laden air is drawn in through the air inflow port 23, forming a whirling current.

The dust receptacle 30 is removably connected to the cyclone body 20, and receives the contaminants separated from the air by the centrifugal force of the whirling
5 air current.

The grill assembly 40 is disposed adjacent to the air outflow port 24 of the cyclone body 20, to prevent a reverse flow of the collected contaminants through that port. The grill assembly 40 includes a grill body 41, a plurality of fine holes 42 formed in an outer circumference of the grill body to form a passage to the air outflow port 24,
10 and a frustoconical contaminant reversal preventing plate 43 formed at the lower end of the grill body.

In use, contaminant-laden air is drawn, by a suction force that is generated at the suction port 2 of the vacuum cleaner, into the cyclone body 20 in a tangential direction through the first connection pipe 21 and the air inflow port 23. This air flows
15 downwardly in the cyclone body 20, forming a vortex air current (indicated by solid-line arrows in Figure 2). During this process, contaminants are separated from the air by the centrifugal force of the vortex air hitting the grill, and collected in the dust receptacle 30.

As the air current reaches the bottom of the dust receptacle 30, the air flows in a
20 reverse direction, i.e. it flows upwardly in the cyclone body 20. The air then flows through the fine holes 42 of the grill assembly 40, the air outflow port 24 and the second connection pipe 22, and then is discharged into the cleaner body 1 (indicated by the dotted-line arrows in Figure 2). Some contaminants, floating in the upwardly-moving air current, will be redirected by the contaminant reversal preventing

plate 43, and thus be reflected into the vortex air current; and some contaminants, which are still entrained in the upwardly-moving air current downstream of the contaminant reversal preventing plate, are filtered out as the air flows through the fine holes 42 of the grill assembly 40, these filtered contaminants also being redirected into
5 the vortex air current.

Any remaining contaminants are discharged through the fine holes 42 and the air outflow port 24. These remaining contaminants are then filtered out by a secondary paper filter 4 provided in the cleaner body 1, while the clean air is discharged outside the vacuum cleaner via the motor chamber.

10 Since the contaminant-laden air drawn in through the suction port 2 is filtered by the cyclone dust-collecting apparatus 10, a reduced amount of contaminants reaches the paper filter 4. Accordingly, the useful life span of the paper filter 4 is extended. Even so, the paper filter 4 is a consumable item, and the user of the cleaner still has to pay for a replacement paper filter each time a filter has to be discarded when it becomes
15 clogged up.

Another disadvantage of this vacuum cleaner is that its dust-collecting chamber takes up a considerable space within the cleaner body. Accordingly, the cleaner body is bulky and heavy, causing inconvenience to the user.

An aim of the invention is to provide a vacuum cleaner having a reusable
20 dust-collecting filter such as a washable dust collecting filter, thereby to reduce repair and maintenance costs of the cleaner.

Another aim of the invention is to provide a compact and lightweight vacuum cleaner by employing a compact cassette-type dust-collecting filter, thereby reducing the space occupied by the dust collecting chamber.

The present invention provides a vacuum cleaner comprising:

a cleaner body having a dust-collecting chamber, and a motor chamber connected to the dust-collecting chamber;

5 a suction port connected to the cleaner body via an extension pipe;

a cyclone dust-collecting apparatus connected to the extension pipe, the cyclone dust-collecting apparatus being arranged to generate a vortex of air for separating and collecting contaminants from contaminant-laden air;

10 a reusable dust-collecting filter removably disposed in the dust-collecting chamber of the cleaner body, for separating and collecting any contaminants not separated by the cyclone dust-collecting apparatus, the dust-collecting filter being constructed to facilitate removal of collected contaminants and for subsequent cleaning; and

locking means for locking the dust-collecting filter in position in the
15 dust-collecting chamber of the cleaner body.

Preferably, the dust-collecting filter comprises:

a filter housing containing a filter and a dust-collecting space;

a filter cover movably disposed on the filter housing to pivot between open and closed positions of the dust-collecting space of the filter housing; and

20 a handle pivotally supported on two opposing sides of the filter cover. Advantageously, the filter cover is provided with an observation window through which collected contaminants can be observed.

In a preferred embodiment, the locking means comprises:

guide grooves formed along opposing sidewalls of the dust-collecting chamber;

semi-cylindrical key recesses formed on respective ends of the guide grooves;
and

semi-cylindrical keys formed on two opposing sides of the handle, the keys being configured to mate with the guide grooves, and adapted to be inserted along the
5 guide grooves and engaged in the semi-cylindrical key recesses.

The invention also provides a vacuum cleaner comprising:

a vacuum cleaner body containing a motor chamber and a contaminant chamber, the contaminant chamber including a filter-engagement structure;

a cleaning head in fluid communication with the contaminant chamber, the
10 cleaning head being adapted to make contact with a surface to be cleaned, and being subject to a vacuum airstream to said surface to draw in contaminants;

a cassette filter disposed in the contaminant chamber, the cassette filter comprising a housing, a removable filter disposed in the housing for collecting contaminants from the airstream, and a lock mechanism supported on the housing, the
15 lock mechanism comprising a key to be matingly received in the filter engagement structure.

Advantageously, the filter-engagement structure comprises a guide groove terminating in a keyway configured to receive the key.

Preferably, the guide groove is sized to receive the key only in its longitudinal
20 orientation, and the keyway is configured to enable the key to rotate into its lateral orientation to lock the cassette filter into the contaminant chamber. Conveniently, the cleaner further comprises a handle integrated with the lock mechanism, whereby rotation of the handle causes a corresponding rotation of the key once the key is inserted into the keyway.

The invention further provides a cassette filter for insertion into a collection chamber of a vacuum cleaner, the cassette filter comprising:

a housing containing a filter for collecting contaminants from a vacuum cleaner airstream, and a dust receptacle;

- 5 a cover attached to the housing and movable between closed and open positions;
an integrated handle and lock mechanism supported on the cover for engagement with a mating structure on the vacuum cleaner.

The invention will now be described in greater detail, by way of example, with reference to the drawings, in which:

- 10 Figure 1 is a perspective view of a conventional vacuum cleaner;

Figure 2 is a sectional view showing the cyclone dust-collecting apparatus of the vacuum cleaner of Figure 1;

Figure 3 is a perspective view of a vacuum cleaner constructed in accordance with the invention;

- 15 Figure 4 is a sectional view showing a dust-collecting filter mounted in the body of the vacuum cleaner of Figure 3;

Figure 5 is a perspective view showing the dust-collecting filter of Figure 4 with its cover in an open position;

- 20 Figure 6 is a perspective view showing a locking mechanism for mounting and locking the dust-collecting filter in an operative position; and

Figure 7 is a detailed view of a key-and-recess structure of the locking mechanism of Figure 6.

Referring to the drawings, Figures 3 and 4 show a vacuum cleaner having a cleaner body 1, a suction port 2, a cyclone dust-collecting apparatus 10 and a dust-collecting cassette filter 300.

5 The cleaner body 1 includes a dust-collecting chamber 100 at an upstream end, and a motor chamber 200 at a downstream end. For convenience of description, the location of the parts of the cleaner will be described with respect to the direction of the airstream or suction force. For example, the dust-collecting chamber 100 is upstream of the motor chamber 200, so the chamber 100 is referred to as being in front of the motor chamber 200. The dust-collecting chamber 100 (see Figure 4) is defined by a
10 front wall 110 and a rear wall 120 which have respective apertures 111 and 121 provided therein. A dust-collecting cassette filter 300 is removably disposed in the dust-collecting chamber 100, and a motor 400 is disposed in the motor chamber 200. The structure of the cleaner body 1 is similar to the structure of the conventional vacuum cleaner. However, as shown in Figure 3, the cleaner body 1 is much smaller
15 than that of the conventional cleaner (see Figure 1) due to the reduced size of the dust-collecting chamber 100. Due to the compact dust-collecting chamber 100, the cleaner body 1 is also compact and lightweight, and accordingly the use and handling of the cleaner is more convenient, particularly for tasks that require lifting and moving the cleaner body 1.

20 As with the conventional cleaner of Figure 1, the suction port 2 is connected to the cleaner body 1 and the extension pipe 3 is connected to a handle 7 and a flexible hose 8. One end of the flexible hose 8 is connected to the aperture 111 in the wall 110 of the cleaner body 1. As the motor 400 is driven, a strong suction airstream force is generated at the suction port 2 via the flexible hose 8 and the extension pipe 3.

As described above with reference to the conventional cleaner of Figure 1, the cyclone dust-collecting apparatus 10 is disposed adjacent to the extension pipe 3, and contaminants in the contaminant-laden air drawn in through the suction port 2 are first filtered out by the cyclone dust-collecting apparatus 10. The construction and operation
5 of the cyclone dust-collecting apparatus 10 are similar to those of the conventional cyclone dust-collecting apparatus.

The removable dust-collecting cassette filter 300 is disposed in the dust-collecting chamber 100 of the cleaner body 1, the filter being arranged to separate and collect any contaminants which have not been separated and collected by the
10 cyclone dust-collecting apparatus 10. The filter 300 is a reusable cassette-type dust-collecting filter, which is advantageous because, after the collected contaminants are removed, the filter can be cleaned (washed) and returned to its position in the dust-collecting chamber 100 for reuse.

As shown in Figures 4 to 7, the cassette filter 300 includes a filter housing 310,
15 a filter cover 320 and a handle 330. The filter housing 310 has a filter 311 at its downstream side, and a dust-collecting space 312 in front of the filter. In other words, the filter 311 is attached to the rear wall of the dust-collecting space 312. The filter cover 320 is hinged to the filter housing 310 by a hinge 321 to pivot between open and closed positions relative to the dust-collecting space 312 of the filter housing 310.
20 When closed, the cover 320 covers the space 312 and is substantially parallel to, and upstream of, the filter 311. The cassette filter 300 is configured to be inserted into the dust-collecting chamber 100 with the cover 320 in the closed position. The filter cover 320 has an intake aperture 322 aligned and in communication with the aperture 111 in the front wall 110 of the dust-collecting chamber 100 when the cassette filter 300 is

assembled into its operating position. Accordingly, after the air is discharged from the cyclone dust-collecting apparatus 10, it flows into the dust-collecting space 312 of the cassette filter 300 via the aperture 110 and the intake aperture 322, where any remaining contaminants are filtered out by the filter 311, and the resulting clean air is discharged outside of the cleaner body 1 via the motor chamber 200. The filter cover 320 has an observation window 323, through which the user can check the amount of collected contaminants in the dust-collecting space 312.

The cassette filter 300 has a handle 330 which is pivotally supported on both sides of the filter cover 320. The handle 330 is pivotable between an assembly position when the cassette filter 300 is being mounted in, or removed from, the dust-collecting chamber 100, and a locked, operative position when the cassette filter 300 is positioned in the dust-collecting chamber.

In order to facilitate reuse of the cassette filter 300 after washing, mounting and removing of the cassette filter must be convenient, while ensuring that the cassette filter remains in place when it is mounted in the dust-collecting chamber 100 in its operative position. To accomplish this, the vacuum cleaner includes a locking mechanism 500 which not only enables easy removal of the cassette filter 300, but also securely locks the cassette filter in the operative position in the dust-collecting chamber 100.

As best seen in Figures 6 and 7, the locking mechanism 500 includes guide grooves 510 formed along two opposing sidewalls of the dust-collecting chamber 100, semi-cylindrical spherical key recesses 520 formed at the distal in ends of the guide grooves, and mating semi-cylindrical keys 530 formed on opposing sides of the handle 330. The keys 530 are configured to mate with the recesses 520 via the grooves 510 when the cassette filter 300 is inserted into the cleaner body 1. In order to mount the

cassette filter 300, its handle 330 is positioned in an upright manner so that the semi-cylindrical keys 530 are inserted into the guide grooves 510 of the dust-collecting chamber 100 with the keys 530 positioned longitudinally in the grooves. When the cassette filter 300 is fully inserted, the keys 530 reach the key recesses 520 at the ends
5 of the grooves 510. The key recesses 520 are configured to enable the keys 530 to rotate 90° to lateral positions.

To lock the cassette filter 300 in place, the handle 330 is pivoted so as to rotate the semi-cylindrical keys 530 through 90°, so that at least a portion of the diametrical surface of each of the keys abuts against at least a portion of the walls of the respective
10 key reces 520. To remove the cassette filter 300 from the dust-collecting chamber 100, as the handle 330 is pivoted back to an the upright position, the semi-cylindrical keys 530 rotate so as to clear any abutment with the walls of the key recesses 520, thereby to unlock the keys and allow movement along the grooves 510. Accordingly, the cassette filter 300 can be removed from the chamber 100.

15 It will be understood that the locking mechanism may be embodied in a variety of structures and configurations. Any structure which provides for mating elements which can be moved relative to one another to provide a releaseable configuration in a first position and a locked configuration in a second position may be used for the locking mechanism. Guide grooves or the like may be provided to facilitate the
20 assembly and locking operation.

Although the invention has been described in the context of a canister-type vacuum cleaner with a cyclone dust-collecting device, the filter cassette described above is not limited to this environment. Thus, the filter cassette could be used in a variety of cleaning apparatus including upright vacuum cleaners, wet vacuum cleaners,

and the like. The filter cassette could also serve as the sole filter for a vacuum cleaner, and is not necessarily limited to functioning as a second filter that is downstream of a cyclone dust-collecting device.

In operation, when the motor 400 of the vacuum cleaner is driven, a
5 sub-atmospheric pressure produced in the dust-collecting chamber 100 causes a strong suction force at the suction port 2 of the vacuum cleaner via the hose 8 and the extension pipe 3. As a result, contaminant-laden air is drawn through the suction port 2 to the cyclone dust-collecting apparatus 10. Firstly, the contaminant-laden air is drawn into the cyclone body 20 in a tangential direction through the first connection pipe 21
10 and the inflow port 23, forming a vortex air current moving downwardly along the dust receptacle 30. The centrifugal force of the vortex air separates the contaminants from the air, and the separated contaminants are received in the dust receptacle 30.

When the air current reaches reversing from the bottom of the dust receptacle 30, the contaminant-laden air is discharged to the cleaner body 1 through the fine holes
15 42 of the grill assembly 40, the outflow port 24 and the second connection pipe 22. At this time, some contaminants floating in the upwardly-moving air in the dust receptacle 30 are reflected by the dust reversal preventing plate 43 into the vortex current. The contaminants remaining in the upwardly-moving air downstream of the dust reversal preventing plate 43 are entrained in the air, and thus are discharged through the fine
20 holes 42 of the grill assembly 40. At this time, any the contaminants larger than the fine holes 42 are filtered out, and accordingly the filtered contaminants are returned to the vortex air.

Meanwhile, any contaminants still entrained in the air, even after passing the fine holes 42, are discharged through the outflow port 24, and filtered at the secondary

filter 300 in the cleaner body 1. The resulting clean air, after filtering through the secondary filter 300, is discharged outside the cleaner, via the motor chamber 200.

When the dust-collecting filter 300 becomes is full of contaminants, it can be removed from the dust-collecting chamber 100, and the contaminants can be cleaned
5 away by washing, agitation or other means. The cleaned filter 300 can then be put back into the dust-collecting chamber 100. The user can also monitor the amount of contaminants collected in the filter 300 through the observation window 323.

As described above, since the reusable cassette filter 300 is employed, there is almost no need to use a consumable filter such as a paper filter. As a result,
10 maintenance costs for this vacuum cleaner are greatly reduced. Moreover, since nothing is discarded, use of this vacuum cleaner will have a positive environmental impact. In addition, since the reusable filter 300 can be made smaller than a paper filter or bag, the size of the dust-collecting chamber 100 in the cleaner body 1 is reduced. As a result, the cleaner body 1 can be more compact and lightweight, making the vacuum
15 cleaner more convenient to use and handle.

Claims

1. A vacuum cleaner comprising:
 - a cleaner body having a dust-collecting chamber, and a motor chamber connected
 - 5 to the dust-collecting chamber;
 - a suction port connected to the cleaner body via an extension pipe;
 - a cyclone dust-collecting apparatus connected to the extension pipe, the cyclone dust-collecting apparatus being arranged to generate a vortex of air for separating and collecting contaminants from contaminant-laden air;
 - 10 a reusable dust-collecting filter removably disposed in the dust-collecting chamber of the cleaner body, for separating and collecting any contaminants not separated by the cyclone dust-collecting apparatus, the dust-collecting filter being constructed to facilitate removal of collected contaminants and for subsequent cleaning;
 - and
 - 15 locking means for locking the dust-collecting filter in position in the dust-collecting chamber of the cleaner body.
2. A vacuum cleaner as claimed in claim 1, wherein the dust-collecting filter comprises:
 - 20 a filter housing containing a filter and a dust-collecting space;
 - a filter cover movably disposed on the filter housing to pivot between open and closed positions of the dust-collecting space of the filter housing; and
 - a handle pivotally supported on two opposing sides of the filter cover.

3. A vacuum cleaner as claimed in claim 2, wherein the filter cover is provided with an observation window through which collected contaminants can be observed.

4. A vacuum cleaner as claimed in claim 2 or claim 3, wherein the locking means

5 comprises:

guide grooves formed along opposing sidewalls of the dust-collecting chamber;

semi-cylindrical key recesses formed on respective ends of the guide grooves; and

semi-cylindrical keys formed on two opposing sides of the handle, the keys being configured to mate with the guide grooves, and adapted to be inserted along the guide

10 grooves and engaged in the semi-cylindrical key recesses.

5. A vacuum cleaner comprising:

a vacuum cleaner body containing a motor chamber and a contaminant chamber, the contaminant chamber including a filter-engagement structure;

15 a cleaning head in fluid communication with the contaminant chamber, the cleaning head being adapted to make contact with a surface to be cleaned, and being subject to a vacuum airstream to said surface to draw in contaminants;

a cassette filter disposed in the contaminant chamber, the cassette filter comprising a housing, a removable filter disposed in the housing for collecting
20 contaminants from the airstream, and a lock mechanism supported on the housing, the lock mechanism comprising a key to be matingly received in the filter engagement structure.

6. A vacuum cleaner as claimed in claim 5, wherein the filter-engagement structure comprises a guide groove terminating in a keyway configured to receive the key.
7. A vacuum cleaner as claimed in claim 6, wherein the key is semi-cylindrical, the guide groove is sized to receive the key only in its longitudinal orientation, and the keyway is configured to enable the key to rotate into its lateral orientation to lock the cassette filter into the contaminant chamber.
8. A vacuum cleaner as claimed in claim 7, further comprising a handle integrated with the lock mechanism, whereby rotation of the handle causes a corresponding rotation of the key once the key is inserted into the keyway.
9. A vacuum cleaner as claimed in any one of claims 5 to 8, further comprising an observation window in the housing to enable viewing of contaminants in the cassette filter.
10. A vacuum cleaner as claimed in any one of claims 5 to 9, wherein the removable filter is washable to enable reuse of the cassette filter.
11. A cassette filter for insertion into a collection chamber of a vacuum cleaner, the cassette filter comprising:
- a housing containing a filter for collecting contaminants from a vacuum cleaner airstream, and a dust receptacle;
 - a cover attached to the housing and movable between closed and open positions;

an integrated handle and lock mechanism supported on the cover for engagement with a mating structure on the vacuum cleaner.

12. A cassette filter as claimed in claim 11, wherein the handle and lock mechanism
5 comprises a bucket-type handle having a protrusion movable between released and locked positions by a corresponding movement of the handle.

13. A cassette filter as claimed in claim 12, wherein the protrusion is a
semi-cylindrical key mounted on the handle with its released position corresponding to
10 a first position of the handle, and its locked position corresponding to a second position of the handle.

14. A cassette filter as claimed in any one of claims 11 to 13, wherein the cover is
hingedly attached to the housing to pivot between its closed and open positions.

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15. A cassette filter as claimed in claim 14, wherein the filter is washable and
replaceable into the housing for reuse.

16. A cassette filter as claimed in any one of claims 11 to 15, further comprising a
20 window in the housing through which collected contaminants can be observed.



INVESTOR IN PEOPLE

Application No: GB 0304532.5
Claims searched: 1-4

17

Examiner: Dave Woolf
Date of search: 23 June 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X:P	1	US 6353963 B1 (BAIR) Column 2 lines 49-55, column 4 lines 42-50.
X	1	GB 2378125 A (SAMSUNG) page 5 lines 5-12
X	1	GB 2368005 A (SAMSUNG) page 7 lines 1-5

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X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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